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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/026,886	12/27/2001	Vladimir Shlain	1078-US	1156

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EXAMINER

TRAN, MAI T

ART UNIT PAPER NUMBER

2129

DATE MAILED: 01/25/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b>		<b>Applicant(s)</b>	
	10/026,886		SHLAIN ET AL.	
	<b>Examiner</b>		<b>Art Unit</b>	
	Mai T. Tran		2129	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 22 December 2005.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-6 and 8-14 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-6 and 8-14 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)             | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                                    |

### **DETAILED ACTION**

A Request for Continued Examination (RCE) under 37 CFR §1.114 of application 10/026886, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, applicants' submission filed on December 22, 2005 has been entered.

Claims 1, 2, 3, 5, 9, 10, 12, and 14 have been amended. Claims **1-6 and 8-14** remain pending in the application and which have been fully considered by the examiner.

### **SPECIFICATION**

The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed. Applicants are suggested to change the title to "System and method of automatic defect classification by tournament strategy".

### **CLAIM REJECTIONS - 35 USC § 112**

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim **3** recites the limitation "each of said objects" in line 2. There is insufficient antecedent basis for this limitation in the claim.

Claim **4** is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

It is unclear what algorithm applicants intend to claim using the term “supervised learning”. Supervised learning is a diverse class of learning technique. A wide range of algorithms have been developed for this task including decision trees, artificial neural networks, backpropagation, Bayesian neural networks, support vector machines, etc ... Applicants need to particularly point out the intended claimed algorithm.

### CLAIM REJECTIONS - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims **1-6, and 8-14** are rejected under 35 U.S.C. 103(a) as being unpatentable over “DCS-1: A Fuzzy Logic Expert System for Automatic Defect Classification of Semiconductor Wafer Defects” by Luria et al, hereafter Luria, and further in view of “Round Robin Rule Learning” by Johannes Furnkranz, hereafter Furnkranz.

**Claim 1**

Luria teaches a system for automatic defect classification (title). Luria fails to teach a system that can apply a plurality of class-versus-class rules to a defect image. Furnkranz teaches the round robin or pairwise class binarization system (*page 3, Figure 1(c). Examiner asserts round robin or pairwise class binarization to be class-versus-class rules*), wherein any of said rules is operative to classify said defect image to one class of a class pair taken from a plurality of class pairs, and wherein any of said classes are associated with at least two of said rules, each rule pairing said class with a different other one of said classes (*page 4, lines 1-11*); and

computer-implemented means for determining to which of said classes said defect image is classified the greatest number of times subsequent to the application of said rules (*page 4, lines 12-15*).

The purpose of this system is to achieve significant improvements in predictive accuracy in reducing a multi-class problem to multiple 2-class problems by learning a classifier for each pair of classes. Therefore, it would have been obvious to a person having ordinary skill in the art at the time of applicants' invention to combine Luria in view of Furnkranz for the purpose of having a system with exact descriptions of defect classes.

**Claim 2**

Luria teaches a system according to claim 1 and further comprising computer-implemented means for automatically generating said rules (*page 2102, paragraph 5.1, lines 2-8*). *Automatically changing the rules as new crystals are being viewed since the comparison being made is for a new crystal and thus the classification of defects is based on wafers from that crystal.*

**Claim 3**

Luria teaches a system according to claim 2 and further comprising a learning set having a plurality of said defect images, wherein each of said objects in said learning set is pre-classified as belonging to one of said classes, and wherein said means for automatically generating is operative to generate said rules using said learning set (*page 2100, paragraph 2.2, lines 17-21*).

*Luria teaches that the defects on the wafer have been classified and the classification information is passed to a database system.*

**Claim 4**

Furnkranz teaches supervised learning classifier system (*page 9, paragraph 6.1, page 10, lines 1-23*). *Examiner interprets supervised learning as learning by example to classify defect images into a class.*

**Claim 5**

Luria teaches a system according to claim 1 wherein:

each of said rules includes a first part and a second part (*Examiner interprets first part as Class A and second part as Class B*),

said means for determining is operative to calculate using said first part a degree of belonging (*page 2101, paragraph 3, right col., lines 15-27*) of said defect image to one of said classes in said class pair,

said means for determining is operative to calculate using said second part a degree of belonging (*page 2101, paragraph 3, right col., lines 15-27*) of said defect image to the other of said classes in said class pair, and

said means for applying is operative to select one of said classes in said class pairs to which said degree of belonging of said defect image is greater (*page 2101, paragraph 3, right col., lines 32-34*). *Luria teaches an expert system using fuzzy linguistic quantifiers to refer to the full range of truth values between true and false. Thus determine the degree of belonging of said object to one or the other of said classes in said class pair. The fuzzy truth value of a conjunctive is the minimum of the conjuncts and the truth value of a disjunctive is the maximum of the disjuncts.*

**Claim 6**

Luria teaches a system according to claim 5 wherein each of said parts comprises at least one fuzzy logic formula including at least one named predicate related to a numerical characteristic of one of said defect images, and wherein said means for determining is operative to calculate said degrees of belonging using said fuzzy-logic formulae (*page 2103, paragraph 5.3, lines 2-5*). *Luria teaches a fuzzy logic expert system in order to translate inexact characterizations of a class into a language that the computer could understand.*

**Claim 8**

Luria teaches a system according to claim 1 wherein said defect images are semiconductor defect images and wherein said classes describe defect classes for application in semiconductor production (*page 2100, title*).

**Claims 9-13**

This is a method version of the claimed system discussed above in claims 1, 2, 3, 4, 5, and 6, wherein all claimed limitations have also been addressed and cited as set forth above.

**Claim 14**

This is a computer-implementable program version of the claimed system discussed above in claim 1, wherein all claimed limitations have also been addressed and cited as set forth above.

**RESPONSE TO ARGUMENTS**

Applicants' arguments with respect to claims 1-3, 5-6, 8-10, and 12-14 under 35 U.S.C. §102 Rejections and claims 1-6 and 8-14 under 35 U.S.C. §103(a) Rejections have been considered but are moot in view of the new ground(s) of rejection.

**CONCLUSION**

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

1. Brecher et al, U. S. Patent No. 5,544,256, discloses an automated defect classification system.
2. "Automatic Defect Classification Using Fuzzy Logic", Luria, M.; Adin, E.; Moran, M.; Yaffe, D.; Haemek, M.; Kawski, J.; Advanced Semiconductor Manufacturing Conference and Workshop, 1993. ASMC 93 Proceedings. IEEE/SEMI, October 18-19, 1993 Pages: 191 – 193.
3. "An Automatic Defect Classification System for Semiconductor Wafers", Sherman, R., Tirosch, E., Smilansky, Z., Orbot Instruments Ltd, Proc. SPIE Vol. 1907, p. 72-79, Machine Vision Applications in Industrial Inspection, 5/1993.



4. "Pairwise Neural Network Classifiers with Probabilistic Outputs", Price, D., Knerr, S., Personnaz, L., Dreyfus, G., Neural Information Processing Systems, Vol. 7, 1994.
5. "Automatic Defect Classification System For Patterned Semiconductor Wafers", Breaux, L.; Singh, B.; Semiconductor Manufacturing, 1995. IEEE/UCS/SEMI International Symposium on 17-19 Sept. 1995, Pages: 68 – 73.
6. "Classification by Pairwise Coupling", The Annals of Statistics, Vol. 26, No. 2 (1998), 451–471.
7. "Oscillating Search Algorithms for Feature Selection", Somol, P.; Pudil, P.; Pattern Recognition, 2000. Proceedings. 15th International Conference on Volume 2, 3-7 Sept 2000 Pages: 406 – 409.
8. "Fraud Detection Using Support Vector Machine Ensemble", SN Pang, D Kim, SY Bang, Proc. ICORNIP2001, 2001,  
<http://www.cse.cuhk.edu.hk/~apnna/proceedings/iconip2001/papers/138a.pdf>.
9. "Multiclass Classification with Pairwise Coupled Neural Networks or Support Vector Machines", Eddy Nicolas Mayoraz, Artificial Neural Networks - ICANN: International Conference Vienna, Austria, August 21-25, 2001, Proceedings.
10. "Pairwise Classification as an Ensemble Technique", Johannes Fürnkranz, Machine Learning: 13th European Conference on Machine Learning, Helsinki, Finland, August 19-23, 2002, Proceedings.
11. "Support Vector Machine Ensemble with Bagging", Hyun-Chul Kim, Shaoning Pang, Hong-Mo Je, Daijin Kim, Sung-Yang Bang, Pattern Recognition with Support Vector

Machines: First International Workshop, Niágara Falls, Canada, August 10, 2002.

Proceedings.

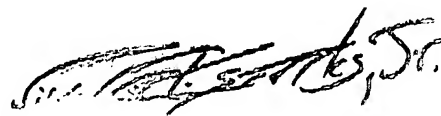
12. "Multi-category Classification by Soft-Max Combination of Binary Classifiers", Kaibo Duan, S. Sathiya Keerthi, Wei Chu, Shirish Krishnaji Shevade, Aun Neow Poo, Lecture Notes in Computer Science, Volume 2709, Jan 2003, Pages 125 – 134.

### CORRESPONDENCE INFORMATION

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mai T. Tran whose telephone number is (571) 272-4238. The examiner can normally be reached on M-F 9:00am-- 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Vincent can be reached on (571) 272-3080. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



M.T.T  
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Date: 1/18/2006

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